AMERICAN
DYESTUFF REPORTER

VOLUME XXII JULY 31, 1933 NUMBER 16

Organization and Operation of

The Modern Dyehouse

By ORMOND W. CLARK

TO MEET the new conditions, the functions of the old-time dyer are expanded and the resultant functional divisions are separated and placed under the control of shade matchers, floor men, and drug men, specially qualified by training and experience to develop and operate these divisions with the utmost efficiency. To coordinate these functional divisions with each other and with the other departments of the plant is the duty of a high-grade executive, the superintendent of dyeing.

There is no doubt but what the man and machine working hours for many concerns will be materially reduced, and to a great extent unified in all plants. Competition will therefore become more than ever a matter of intelligent management.

Mr. Clark's article is consequently timely in that it sets forth in a lucid and well systematized manner the various elements of modern dyehouse organization and management.

The modern dyehouse, in line with the trend of scientific management, distributes its activities under the control of functional specialists supervised by a high-grade executive. The technical phases of dyeing have become too complex, the intensive production requirements have become too exacting, and the labor problems have become too profound, to permit the efficient execution of all their details by the same individual who is responsible for adequate supervision of the dyehouse.

The superintendent of dyeing is a high-grade executive, technically trained in chemistry, engineering, and management, with sufficient practical dyehouse experience to mellow his judgment and to guide his theory into profitable channels. His compensation is commensurate. He is responsible to the management for the maintenance of quality standards, production schedules, minimum costs, and technical superiority. He supervises the dyehouse and drug room and coordinates them with the laboratory and the plant to achieve the minimum production costs consistent with a high quality output.

Routine shade matching is delegated to moderately paid men with ability to match shades quickly and accurately. They are freed from all the other details of dyehouse operation. The increased opportunity to concentrate on one task produces better matches in less time. Astonishing facility in the shading of batches to standard is acquired by these specialists.

The matchers' office receives abundant north light, free from reflected components coming from adjacent structures or foliage. A ground glass skylight inclined to the north is excellent. The interior of the office is painted dead black to minimize reflected light. Supplementing the true daylight are a high grade artificial daylight lamp and ordinary artificial lights enclosed in light-proof dead black booths.

A file of master formulas is kept in the matchers' office. These formulas have been standardized by repeated production use. Swatches of material in all stages of processing from dyeing, including intermediate steps if necessary, to the finished material, are attached to the formula cards, and provide accurate data for the matcher. Tentative formula cards contain all available data and when repetition proves them to be correct, master formula cards are issued.

The primary standard shades are mounted in light-proof folders and protected from atmospheric deterioration. Standards which cannot easily be replaced, which are unusually fugitive, or which are expected to receive excessive use, are matched perfectly by the laboratory, and these secondary standards are used in the routine matching. Periodic checking of the standards in use, either against portions saved for that purpose, or against the standards in the customer's possession, permits replacement upon evidence of perceptible change and may prevent rejection of large off-shade lots.

In case the matcher questions the accuracy of his match the trial patch is submitted to the superintendent of dyeing before removal of the material from the dyeing

machine. Likewise, if trouble arises during the dyeing operation, recourse is had to the superintendent. All shades are passed upon by the superintendent after the first drying—release of the lot for further processing requiring his approval. If any change in shade is anticipated during specific finishing operations, the superintendent's approval follows that operation and precedes further processing of the lot. By this progressive approval of questionable shades unnecessary processing of imperfect material is eliminated.

Storage

Proper storage and dispensing of raw materials is assured by an orderly, well-systematized drug room under the joint supervision of the superintendent of dyeing and the plant chemist. Accuracy in the dyeing formulas is promoted and the data for a good cost system are provided.

Powdered dyes are kept in tight self-closing, easily accessible containers. Pastes are stored in containers which minimize evaporation and permit rapid thorough agitation before withdrawals. Chemicals are kept in dry, substantial, covered containers. The stock is maintained under the proper conditions of temperature and humidity to insure optimum preservation and in a physical arrangement which aids frequent and easy inventorying.

Powders and dry chemicals are kept warm and dry. Pastes are kept cool, away from air currents, and are never exposed to freezing temperatures. Moisture content of the pastes is periodically standardized by the chemist. Rigid standardization of the drug room stock removes one variable from dyehouse operation.

Good scales of adequate sensitivity for the dispensing of the drugs are provided to cover the various ranges, from small dyestuff adds to large quantities of chemicals. A very convenient system of weights, promoting both speed and accuracy, is the decimal pound, adapting the easy mental calculation of the metric system to the customary plant use of the English units. Calculation of costs, percentages, adds, etc., is simplified, often requiring only the moving of a decimal point. Matchers find it easy to estimate adds in percentage of the starting formula.

All weighed materials are doubled checked before issuance, and repeat formulas are checked against the original to prevent expensive errors in production. Delivery of material is made only upon written requisition from the matcher. Whenever possible, materials are issued in the proper condition for immediate addition to the dyeing machine. The quantities of materials for each shade are accurately recorded and the psychological effect of this impartial check, subject to review by the superintendent of dyeing and the plant chemist, acts to keep all formulas to minimum quantities. Preliminary cost data, tabulated by the drug men as it accumulates, is daily forwarded to the cost department.

Floor Men

To secure maximum machine and labor production is the task of floor men, who supervise the mechanical details of production. As specified in writing by the matcher, they supply the machines with cloth; checking lot number, yardage, and superficial condition of the cloth. They ascertain as well as they are able, that the cloth is well dried, free from stains, sewed with good seams, not tender, and not off white. In brief, it should be suitable for dyeing. If the machine speed is variable they adjust it to accord with the matcher's specifications. They remove the completed work from the machines and convey it to the next department. For padder work they run the trial patches from the auxiliary tub with the aid of a small trial padder, thus minimizing the non-productive time of the large padder. They complete the jig patches for the jig operators and submit them to the matcher.

The floor men inspect daily the condition of squeeze rolls, the condition of machine bearings, the cleanliness of equipment, the tightness of water and steam valves, and similar factors which quickly reduce the percentage of first quality output. Their function is to relieve the shade matcher of much detail, and the directly productive labor of all except directly productive tasks. Production efficiency of men and machines is consequently high.

Superintendent

Untrammeled by routine production details, the superintendent of dyeing is free to investigate dyehouse procedure and to determine optimum dyeing conditions with great exactitude. The old-time dyer, busy and worried by countless details, found it difficult enough to develop formulas which would work, without undertaking the careful experimentation required to find the best formula. Dissection of dyeing processes into elements, studying the *raison d'être* of these elements, justifying each step in the light of scientific knowledge, and postulating the possible improvements, often results in increased efficiency. Possible profitable variations in plant procedure are carefully submitted to laboratory trial, then to small scale plant trial, and finally to large scale plant trial.

To aid in the analysis and improvement of dyehouse procedure, the superintendent of dyeing marshals the scientific knowledge and precise technique of the plant chemist to complement his own knowledge and experience. He searches the literature—textbooks, periodical and patent, both native and foreign, and secures new viewpoints and pregnant ideas which assist in attaining technical superiority. Well maintained liaison with the leading dyestuff and raw material manufacturers keeps the superintendent conversant with innovations at their inception. By visits to other plants, attendance at his professional society meetings, and assiduous cultivation of all sources of information he determines the best contemporary practice.

Dyeing machinery is minutely examined from the viewpoint of structure and function, to discover possible improvements which can improve the quality of output, raise the permissible operating speed, or require less labor exertion. Minor changes in machine design may greatly increase operating efficiency. Whenever possible, fallible human control is replaced by exact mechanical devices, temperature controls, level regulators, chemical tests, etc. Inadequate supply pipes and outlet pipes are changed. Specifications for new machinery can be drawn up whereby a slightly enhanced first cost is more than justified by consequent operating economy and efficiency, and whereby the indicated operating economy may prove the old equipment is too expensive to keep. Not in the 17th Century, but within the year, the writer has seen many dyehouse anachronisms; 150 gallon jigs with 1½ inch waste valves, and with badly warped wooden rollers whose gudgeons rode on the bearing housing, the bearing proper having been worn completely through; padders with rudimentary plain babbit bearings which wore so rapidly that the padder set had to be constantly adjusted during the day; padders whose construction necessitated the readjustment of the set every time the rubber rollers were separated during a lull in production, reel machines which required time to fill, heat and empty; out of all reasonable proportion to the time utilized in the actual scouring and dyeing operations.

Continual check upon all the details of dyehouse procedure is maintained by the superintendent of dyeing. The matcher, floor men, drug men, and operatives are kept alert and efficient. The matcher's work is checked for accuracy of match, total output, number of adds per shade, correct allocation of equipment to the material and correct proportioning of liquor to material. The floor men are checked for machine operating time and their general supervision over the cloth, the equipment and the operatives. The drug men are checked for the efficiency of their service to the operatives, their accuracy, and the efficiency and economy of their store keeping.

Cooperation

A phase of dyehouse operation which has received little attention is the human element. From a merely callous business viewpoint it pays to provide healthful and attractive working conditions and to study the human side of plant operation. Some plants have taken a broader viewpoint and feel a certain responsibility towards their employees' welfare, a viewpoint not wholly engendered by a stark desire for profit.

A properly installed, well operated incentive system, preferably task and bonus, achieves a many-sided goal. The cooperation of the employees becomes wholehearted. The men learn how to work efficiently, their earnings increase, their self-respect rises, their value to the plant and even to the community undergoes intangible improvement. The dyehouse secures a fully adequate, direct financial profit due to the much lower labor cost per unit of product with increased quality. Less easily computed, but nevertheless real, profits accrue from the lessened direct supervision.

The superintendent of dyeing, for the information of the plant executive who routes the orders through the mill, designates the preferable treatment to prepare the various materials for dyeing according to the dyeing method they are to undergo. Thus, unless for special reasons such preparatory treatment is incompatible with the plant routine, the designated adequate preparation is secured and unnecessarily involved or expensive preparation is often prevented. In any case, there is coordination between the dyehouse and the grey room.

Through frequent conferences with the plant salesman, information is secured regarding customer reactions and competitive products, and suggestions of novelty effects or improved products are made which may secure new business. The salesmen gain sufficient familiarity with dyehouse requirements and possibilities to considerably enhance their selling intelligence. Criticisms of dyehouse workmanship by the customers are imparted by the salesmen who receive the brunt of them, and the growth of customer dissatisfaction stopped at its inception by quick action in the dyehouse.

Frequent conferences with the general administrative executives keep the superintendent of dyeing fully informed of the many indirect factors bearing on his work. Market trends are anticipated, keeping drug room stocks at a minimum and facilitating correct employment of dyehouse personnel. New fabric constructions are discussed as to the feasibility of handling them in the dyehouse and indicated changes can be made ahead of time. Preliminary estimates of the dyeing costs of new shades, new fabrics, or the effects of quantity of output upon cost are submitted. The broader aspects of dyehouse operation are articulated with the general plant policies.

Laboratory

A most valuable adjunct to the dyehouse is a well staffed and well equipped laboratory, organized as a profit producing unit, and not maintained by the mill merely as a costly luxury or as a necessary evil. Properly supported and skillfully directed, the laboratory is a distinct asset to any plant, and especially to the dyehouse.

In the majority of plants the chemist is too busy with the multitudinous exactions of general plant control and the never ending stream of troubles flowing in from production departments to devote a full measure of justice to the dyehouse. As the complex conditions arising from new fibers and complicated dyeing processes continually increase, the load becomes still more onerous to the already overburdened chemist. The superintendent of dye-

ing possessing a sound technical training eases the burden of responsibility upon the chemist and facilitates the smooth coordination of dyehouse and laboratory.

The most obvious function of the laboratory is to insure by analysis that all raw material shipments conform to the set standard of strength and purity, and that their money value is not surpassed by competitive products. Any textile chemist can testify that it is not unusual for a plant which does not submit its raw material purchases to chemical analysis to be buying highly adulterated dyes, finishing materials, scouring compounds, etc., at exorbitant prices. Very rarely does such a plant have the good fortune to confine its purchases to those concerns of integrity which are sos rare in the textile field. Even when all dyes and raw materials are purchased from reputable manufacturers who know deliveries will be checked by analysis an occasional inadvertent variation in shade or strength will appear. Issuance of such knowledge to the operating department before use prevents costly damages and delays to production.

As essential as the testing of raw materials is the checking for fiber type and dyeing properties of all goods entering production. Canton, Italian, tussah, viscose, nitro, cellulose, acetate, cuprammonium, cotton, linen, rhea, jute, wool and immunized fibers are differentiated before production dyeing of a lot is undertaken and unusual dyeing properties are noted for the dyehouse. Especially among the artificial fibers where some types are made by several manufacturers, where various degrees and types of deluster occur, and where the same type made by the same manufacturer may vary from lot to lot, is the preliminary laboratory study as thorough as possible in order to render production mishaps infrequent. It is even worth while to test every lot of such a staple fiber as cotton at its point of entrance to the dyehouse, to insure its conformity to the standard reactions of absorbency, color, etc., set up for a specific construction and manufacture of fabric. To designate the characteristics and peculiarities of goods by simple laboratory tests is quick and inexpensive, and the correction or amelioration of defects is relatively easy. To observe them first during the dyeing is disconcerting and quite likely to be expensive.

To maintain a high standard of quality the laboratory checks the dyehouse output from time to time. Penetration, levelness, and other characteristics of good workmanship are observed. Submission of the shades to the fastness tests they are supposed to meet demonstrates their conformity to the established standards. Routine fastness tests certify the quality of all shades of every fast color lot.

All new shades are matched in the laboratory and the formula thus derived, while it may not hold exactly true in the plant, will indicate the quantities necessary and will designate the exact dyes required, so that production dyeing will be aided and possible seconds prevented. This laboratory matching is particularly valuable in the dyeing of acetate silk or in the dyeing of vat and naphthol dyes, where it is extremely difficult, often impossible, and always expensive to rectify errors.

The modern dyehouse attempts to maintain progress by specialization of function and close coordination of dyehouse, laboratory and dye manufacturer. Research, with rare exceptions, is still too altruistic a conception to be actively postered by the American textile industry.

A recapitulation of the salient points in the modern dyehouse shows:

1. Only one high-priced executive—a man of training and ability commensurate with the remuneration.
2. Specialization of operations into functions supervised by moderately paid specialists.
3. Accurate cost data supplied to the cost department.
4. Technical superiority, resulting in
   a. High quality product.
   b. Minimum seconds.
   c. Satisfied customers.
5. Efficient, contented employees.
6. Maximum production at minimum cost.

Sodium Phosphate Institute

On July 5, 1933, the Sodium Phosphate Institute, Inc., was incorporated pursuant to the membership corporations law of the State of New York. The purposes are:

"To foster the industrial interests of those engaged in the sodium phosphate industry;

"To promote a more comprehensive relationship between those engaged in the production and those engaged in the consumption of its products;

"To engage in research work, directed toward developing new uses and more extended consumption of sodium phosphate and its products."

On July 13, 1933, the Institute held its incorporation and first directors' meetings and the following officers were elected:

President, William B. Thom, Warner Chemical Co.; vice-president, George A. Benington, Bowker Chemical Co.; secretary-treasurer, Robert T. Baldwin.

The office of the corporation is located at 50 East 41st Street, New York City.

New Pot Eye

Parock, a specially compounded rubber material, developed by the Manhattan Rubber Mfg. Division of Raybestos-Manhattan, Inc., Passaic, N. J., is now being used for the manufacture of pot eyes that are practically unbreakable.

The Parock material takes a high polish which it retains permanently. Pot eyes made of this material are said to wear indefinitely, do not oxidize or deteriorate due to age, and are unaffected by dyeing and bleaching solutions. They are tan color and are furnished in all sizes—2½ inches to 15 inches in diameter.

PROCEEDINGS OF THE
American Association of Textile Chemists and Colorists

JULY 31, 1933

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What the Microscope Shows of Textile Fibers*

By **SIDNEY MELTON EDELSTEIN**
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IN EXAMINING textile fibers under the microscope, high magnifications are not often necessary. The lower powers of magnification are most suitable for general textile work. The special textile microscopes usually contain low power objectives.

It is common for the beginner to obtain a microscope that is capable of giving an image many times larger than is needed. As the higher power objectives are much more expensive than those of lower power, considerable money can be saved by buying the correct microscope for textile use.

If we wanted to study a mountain from a distance and desired to obtain some information as to the general topography, we should not use a telescope so powerful that a leaf of a tree growing on the mountain would fill our field. If we did use such a powerful telescope, it is doubtful as to whether much would be learned of the topography of the mountain. This same principle should be used with the microscope.

Magnifications over 250 diameters are hardly ever needed in textile microscopy. For most work 100 diameters are sufficient. Even 100 diameters is a considerable magnification. As an example of the magnitude of 100 diameters, suppose we had a single square yard of

*Presented at meeting, South Central Section, May 27th.

ground and magnified it so that a city block was covered. We would then have a magnification of 100 diameters. When we magnify a fiber this much, we should be certain of seeing considerable of its structure.

The textile microscope is an excellent instrument for the detection and examination of textile fibers. Chemical tests are sometimes necessary in addition to a simple microscopical examination. Most of these chemical tests may be carried out under the lens of the microscope.

Careful judgment should be used with the microscope. The area under view is exceedingly small. If we are not certain that the sample in view is representative, our results may be misleading.

If in the examination of a sample we detect a certain fiber, we may feel certain that this fiber is present. If our examination proves negative—that is to say that if we do not detect the presence of a certain fiber, we should be careful in concluding that this fiber is absent. It might be possible that in our particular sample, the fibers for which we have been looking are scattered unevenly throughout the sample. When we realize how small our field of view is, the possibility of missing the thing for which we have been seeking appears great. We may have to make many more examinations before we may feel certain that the fiber for which we have been looking is absent.

In contrast to the chemical analysis of fibers, the microscope allows their detection without their destruction. The microscope presents a picture—chemical analysis only obtains an indication of the picture.

The chemical analysis of fibers and fiber mixtures usually involves their destruction. When we obtain our results by chemical methods, we still do not know whether the fibers were round or oval, regular or irregular. Most of the important physical structure has been missed.

The chemical analysis of several different kinds of viscose rayon would probably give the same chemical results. The physical form of the filaments might be quite different. The physical form would have a bearing on the properties of the finished product but chemical analysis indicates nothing of this.

As another example of the differences between chemical and microscopical analysis, let us take the case of a cotton and wool yarn. Suppose we are to find the percentages of cotton and wool in the yarn. If we attack the problem chemically, we must first weigh a fairly large sample and then digest it with caustic soda for some time to remove the wool. The sample is then washed, dried, and reweighed. Several hours are consumed in this.

Contrast this same analysis with the microscopical method. A small sample of the yarn would be untwisted and the fibers laid parallel on a glass slide. We might also make cross-sections of the yarn. The wool and cotton fibers could easily be distinguished with the lens of the microscope. We would merely make a count of the two kinds of fibers and would have our analysis finished in a short time. We would also learn something as to the kind of wool and cotton present and how they were twisted together.

Fibers are examined under the microscope longitudinally or by means of cross-sections. For most work, both cross-sections and longitudinal views are necessary.

The longitudinal views are prepared by mounting a small number of the sample fibers on a glass slide. Different media may be chosen for mounting. The choice depends on what characteristics are desired. The most generally used mounting media for textile fibers are air, water, glycerine and Canada balsam. Each one of these has its own particular use. Air shows a maximum of surface detail and practically nothing of the interior of a fiber. Balsam reveals the interior structure, but very little of the surface. Glycerine gives mostly interior detail while water shows mostly exterior fiber characteristics.

Sometimes a combination of mounting media may be used. Suppose we wish to see both the scale markings and the central channel of a wool fiber at the same time. A small drop of balsam is placed at one end of the fiber and allowed to run along its length. There will be some places where the balsam only covers about half of the fiber. If the fiber is examined at this point, we see both interior and exterior detail. We have used a combination of air and balsam as our mounting media.

There are two general methods of preparing cross-sections.

The cork method requires only the simplest of materials. To prepare these sections, we need only to obtain some small corks, a sewing machine needle, some strong thread and a sharp razor-blade.

The needle is threaded and pushed through the long axis of the cork. A bundle of the fibers to be examined are put through the loop formed by the thread and needle. The needle is pulled back through its hole until this hole is filled with the sample fibers.

After a little practice, thin sections can be cut through the cork with the razor-blade.

The cork completely surrounds the cross-sections of the fibers and acts as a supporting medium.

This method is very fast and does not involve expensive equipment. For most work on transparent fibers, the cork method is adequate.

The paraffin method is more difficult and expensive, but the results are more suitable for semi-transparent and dark colored fibers.

To prepare the sections, fibers are mounted in paraffin much as a wick is mounted in a candle. This may be done by dipping the fibers into melted paraffin, allowing the paraffin to cool and then repeating the process until enough paraffin surrounds the fibers to support them. The candle may also be made by using an imbedding outfit.

Very thin accurate sections are cut from the candle with

a microtome. The automatic rotary microtome is best. A hard microtome may be used but it is exceedingly difficult to manipulate.

The sections are mounted on a slide and the paraffin is removed with benzol. A drop of egg albumen fixative is placed on the sections and the slide is heated gently. The heat coagulates the albumen and makes the slide permanent.

A cotton fiber is a single cell. Chemically it is mainly cellulose. Small quantities of proteins, oils, sugars and waxes are usually associated with the fiber.

A ripe cotton fiber is a long flat twisted tube. Running length-wise through the fiber is a central channel of irregular shape. It is within this channel that most of the oils and other substances are found. On the surface of the fiber are seen a number of small dark mountings.

The cross-section of the cotton fiber is irregular and usually kidney-shaped.

If we put a few drops of cuprammonium solution on some cotton fibers under the microscope, we soon find that the fibers have not such a simple structure as an ordinary examination shows.

The fibers begin to swell rapidly. They coil and twist like a number of small worms. Some fibers will swell evenly throughout their length. Others will have alternate areas of swelling—giving the fiber an appearance of a number of dumbbells placed end to end.

In practically all cases, the swollen fiber is found to be wrapped by a band of material that is not attacked by the swelling solution. This band, which is called the cuticle, gives the appearance of a coiled spring surrounding the body of the fiber.

The cuticle is a thin outer skin covering the cotton fiber. It is a highly resistant substance, differing from the rest of the fiber.

During the swelling the cuticle becomes ruptured in places. As the swelling increases, the cuticle becomes coiled around the body of the fiber.

At most areas of no swelling, thin plates are seen cutting the fiber axis vertically. These plates are present in the cotton fiber just as plates are present in a piece of bamboo. The plates are evidently of different material than the body and cuticle of the fiber. These plates are swollen to some extent by the cuprammonium solution, but they do not lose their identity as does the body of the fiber.

A mercerized cotton fiber appears different from the natural fiber under the microscope. After mercerization, the fiber has become rounded. It is more transparent and consequently can be observed more easily under the microscope. Mercerization has caused the fiber to untwist and to become more regular. The central channel of the fiber has become narrowed. In some cases the channel has practically disappeared. The cross-section of the fiber is no longer kidney-shaped, but has become round or oval.

When we put a drop of our cuprammonium solution on the fiber, it begins to swell more rapidly than did the natural fiber. The swelling is much more regular throughout the length of the fiber. There is less of the dumbbell effect. The cuticle is still present, but some of the fiber plates have disappeared.

Chemically, the rayons are the same with the exception of the acetate. Structurally, the rayons differ from one type to another and in many cases they differ from one maker to another.

Rayon filaments are fine cylinders of indefinite length. These filaments have no structural parts as do the natural fibers. Most rayon filaments have no central channel.

For one particular sample of rayon, the filaments have more uniformity than would be found in a single sample of cotton or wool.

The rayon filaments present many different kinds of cross-sections. These differences are not noted in a single sample but occur in different types.

Some cross-sections are very round while others are flat. Some others have jagged edges while others have edges that are well rounded. The shape of these cross-sections depends on the method of manufacture and especially on the method of coagulation. It is said that a slow coagulating bath gives filaments having irregular cross-sections while a fast coagulation usually makes a flat or round cross-section.

The shape of rayon cross-sections are important because they have considerable effect on the physical properties of the finished yarn or fabrics.

A yarn made of perfectly round rayon filaments may be more resistant to rubbing than would be a yarn made of rayon filaments having irregular cross-sections. The tendency of these two yarns to untwist would be different. The irregular shaped filaments should grip each other more readily than would the round filaments. The luster of the two yarns would be different. The light striking the tiny grooves in the irregular rayon would be reflected differently than it would be from a smooth rounded surface.

A difference in wearing qualities would be noticed in the case of two rayons having irregular cross-sections if the edges of one were rounded and the edges of the other jagged. The jagged edges would more easily rub off in wear than would be the rounded edges.

If we had two rayons differing only in the fact that the filaments of one had a central channel, we would also find differences in the finished product. There would be a difference in insulation properties as well as strength and weight.

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Proceedings of the American Association of Textile Chemists and Colorists

The Application of Spectrophotometric Color Analysis to Dyeing[1]

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A DISCUSSION of the application of spectrophotometry to dyeing must be based on the fundamental facts concerning the production of color. Ultimate interest centers about the appearance of an illuminated sample; the general case is represented diagrammatically on the following page. (Fig. A) The light source emits radiant energy which consists of electromagnetic waves of a great variety of wavelengths; these different wavelengths may be sorted out by means of a prism, and a statement of the relative amounts of energy resident in the different wavelengths constitutes a complete description of the quality of the light from the source. Such *spectral energy distributions* are shown in Figure 1 for blackbody radiations approximating (a) incandescent lamp light, (b) north skylight on an overcast day, and (c) north skylight on a bright day. One sees readily from curve (a) that tungsten light contains relatively less of the short wavelength radiations which look blue and has most of its energy in the red end of the spectrum.

When light falls on a sample some of it is reflected and its spectral energy distribution is in general changed. The reflected energy is equal to the incident energy multiplied by the percentage reflected or the *reflectance;* hence the *spectral reflectance* of the sample defines its power to modify the light reflected from it. Spectral reflectance curves, of which Figure 2 shows examples, are commonly called spectrophotometric curves since they are obtained by means of a spectrophotometer.

This much of the process of the production of color has been physics, but when the radiant energy coming from the sample falls on the eye there are introduced questions of psychology. It is necessary to distinguish carefully between the *stimulus* of color consisting of the radiant energy entering the eye, and the *sensation* of color in the brain—they are as different as cause and effect, and often widely different stimuli produce the same sensation. It is an experimental fact that the sensation due to any stimulus whatever can be duplicated by the sensation due to a mixture in the proper amounts of three arbitrarily chosen primary stimuli. In more concrete terms, whatever is placed in one side of a photometric field can be "matched" by the proper amounts of three primary stimuli on the other side. If two stimuli, though different, are each matched by the same amounts of primaries or in other words by the same *equivalent stimulus,* the stimuli themselves will produce equal sensations—this points out the usefulness of equivalent stimuli. To find the equivalent stimulus of a sample of radiant energy coming into the eye, the radiant energy is thought of as broken up into the sum of many stimuli of the different wavelengths shown in the spectral energy distribution; for each of these is determined the equivalent stimulus and the sum of the equivalent stimuli is the equivalent stimulus for the complete radiation. The curves on the next page (Fig.B) give the equivalent stimuli for unit amount of each of the spectral stimuli,[2] from which the equivalent stimuli for the amounts shown in the spectral energy distribution of the radiant energy can be gotten by proportion. The considerable amount of arithmetic incidental to this process can be performed rapidly with

Mr. Pineo is a Senior Fellow of the Textile Foundation and is working under the direction of Prof. A. C. Hardy in the color measurement laboratory, Department of Physics, Massachusetts Institute of Technology.

The subject of the Application of Spectrophotometric Color Analysis to Dyeing was discussed at a meeting of the N. N. E. Section of the A. A. T. C. C. on May 13, 1933, following a demonstration in the Institute Laboratories of the operation of the new M. I. T. Color Analyzer.

Any study which may lead to the more direct application of spectrophotometric color measurements to the practical application of dyestuffs is of importance, and the work which Mr. Pineo is doing is highly commendable.—L. A. O.

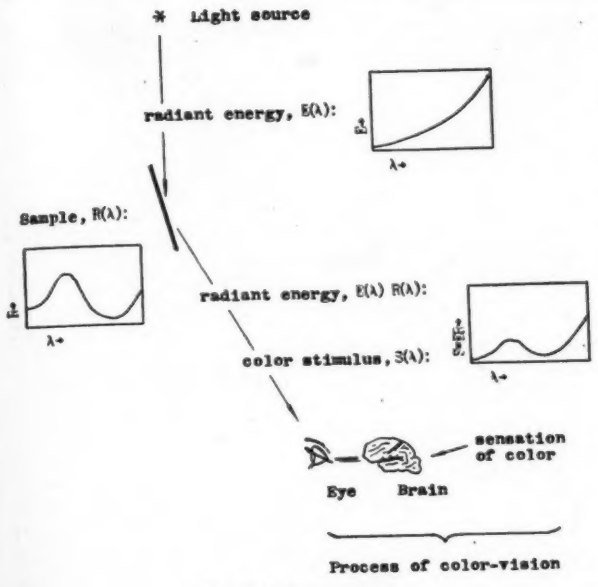

Fig. A—Production of Color

an integraph, which gives directly the amounts of the three primaries which match a given stimulus.

The whole process indicated in Fig. A can be summarized as follows: the quality of the light from the source is defined by its spectral energy distribution, and the color-properties of the sample are defined by its spectrophotometric curve; the product of the two is the spectral energy distribution of the modified light coming to the eye, which integrated by the spectral equivalent stimuli given (in Fig. B) results in three numbers which define the sensation in the brain of a normal observer.

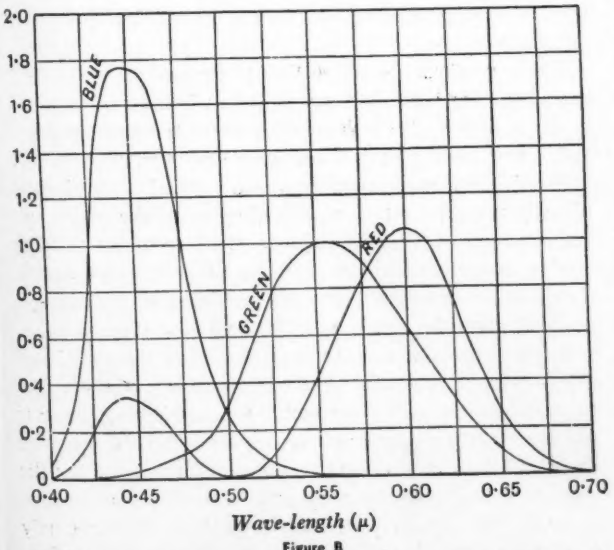

Figure B

These curves give the amounts of blue, green, and red primary stimuli which match unit amounts of spectral stimuli.

This method has certain advantages. In the first place, the illumination and viewing of the sample can be standardized, since they are accomplished mathematically and not actually. The spectral energy distributions of Figure 1 define three illuminants which are representative of actual illuminants of practical importance, but are not subject to the unavoidable variations in practical illuminants due to the weather, wall hangings, etc. Similarly the spectral equivalent stimuli of Fig. B define an internationally standardized observer who is not subject to the wide variations in color-vision known to exist, and who can simultaneously be in all the color laboratories of the world. Thus all elements of the process are standardized except the spectophotometric curve which defines the properties of the particular sample. Although the spectrophotometric curve is but one link in the chain, it contains all the experimental data necessary to obtain in a given case, and hence from an operational point-of-view assumes so great an importance that the whole method is often called the spectrophotometric method of color measurement. However it must be emphasized that the spectrophotometric curve is merely a definition of certain properties of the sample itself and has nothing to do with how that sample may subsequently be illuminated or with the color-vision of an observer; the spectrophotometric curve is the result of an objective physical test on the sample. Since all the experimental work necessary to define a color has been reduced to a physical test independent of vision, the precision of the method is not set by the very definite limitations of vision, and differences of color can be measured which can not be seen. Greatly increased sensitivity is the second advantage of the method.

This method is not new, but until the recent introduction of photoelectric cells and vacuum tubes it has been prohibitively expensive to obtain the spectrophotometric data, the curve on a single sample requiring several hours of fatiguing work by a skilled operator. A modern photoelectric spectrophotometer[3] automatically measures the sample and plots the curve in a few minutes, and with much greater accuracy.

The problems of the dyeing industries may be grouped under several headings. First there are *problems of specification.* These problems arise from the fact that until recently it has been necessary to specify colors by means of samples. Today we can specify a sample by its spectrophotometric curve or a color sensation by its equivalent stimulus. For instance, in preserving color standards, we are really interested in preserving standard samples; the samples themselves may fade, but their specification in the form of a spectrophotometric curve can be preserved indefinitely. Another instance arises in the standardization of dyestuff strengths. Two samples dyed with slightly different concentrations may produce very similar sensations, whereas the spectrophotometric specifications of the samples themselves will show a distinct

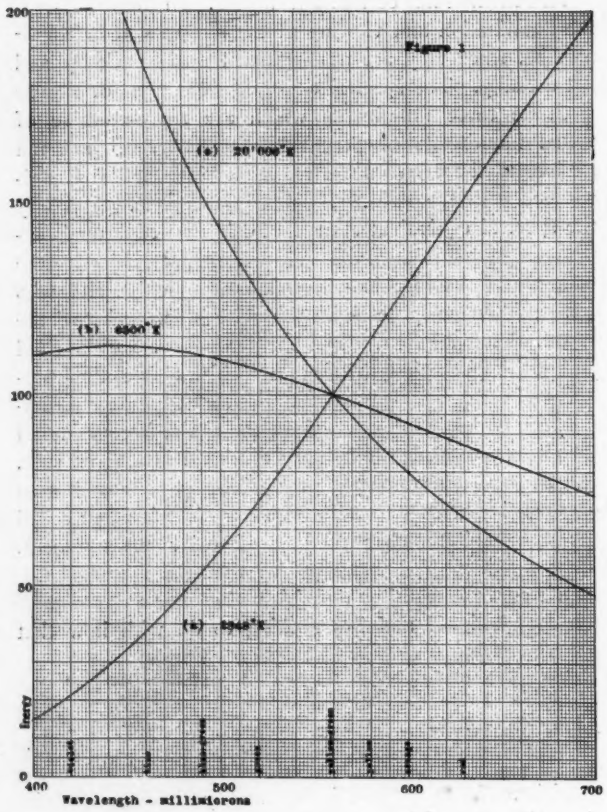

Fig. 1

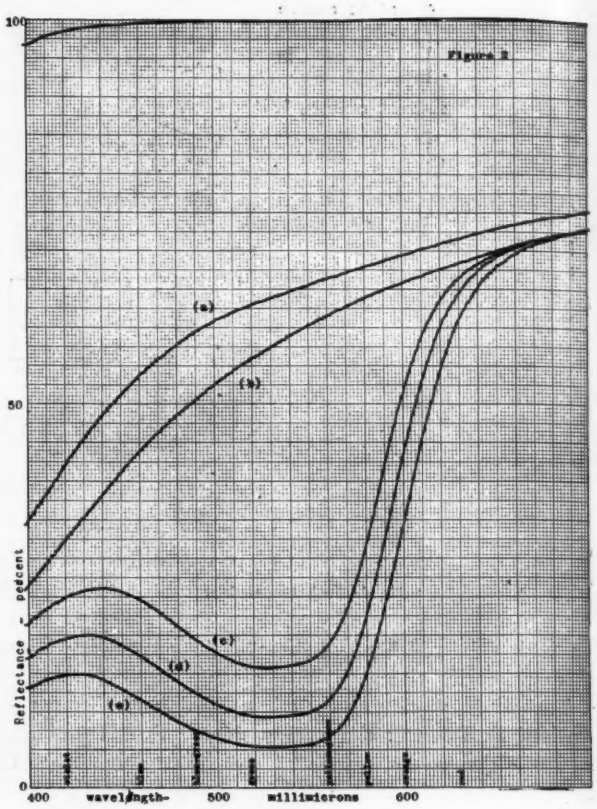

Fig. 2

difference; as before, we are fundamentally interested in duplicating the effect of a standard concentration on a sample, and very little interested in questions of vision. The spectrophotometric means of specifying a sample independently of vision is a powerful tool for the solution of these problems.

A second group might be called *problems of tolerance* because they require the evaluation of small differences in color sensation in order that standardized tolerances may be established to settle the frequent divergences of opinion on matches and to rate the ability of materials to withstand exposure to light and laundering. The spectrophotometric method of color measurement results in three numbers which specify with great sensitivity the color sensation of a hypothetical normal observer, so that color differences can be measured which can not be seen by a human observer. Furthermore the three numbers can be to such a scale that the difference between two samples is at once apparent in terms of least perceptible color differences. To say that two samples differ by three and two-tenths times the least perceptible amount is the best possible answer to the question "how well do they match?" Furthermore the method indicates whether that difference is towards the green, yellow-green, or violet, etc. The advantages of three numbers to describe a color sensation becomes at once apparent when one tries to describe it in words! Three numbers are easy to record and to file systematically. Oftentimes helpful relationships may be shown between colors when they are plotted as points on the color triangle.

Other problems relate to the laws governing the *application of dyestuffs*, and constitute an important field for research as very little about the subject is known at present. For such research the spectrophotometric method offers this advantage over the visual method; that whereas visually we are aware only of changes in the color sensation produced by a material as dyes are added to it, in the spectrophotometric method the process is reduced to its elements and we see how the addition of dye changes the characteristics of the material, and how these complex changes in the material are transformed in the process of color-vision to relatively simple changes in sensation. The process of color-vision is essentially a simplifying process: the eye does not appreciate in the sensation the complex nature of the stimulus, and consequently can tell from the appearance of a sample very little about its fundamental nature. The spectrophotometric method does not rely upon inferences drawn from superficial visual sensations alone, but presents all the steps in the process of the pro-

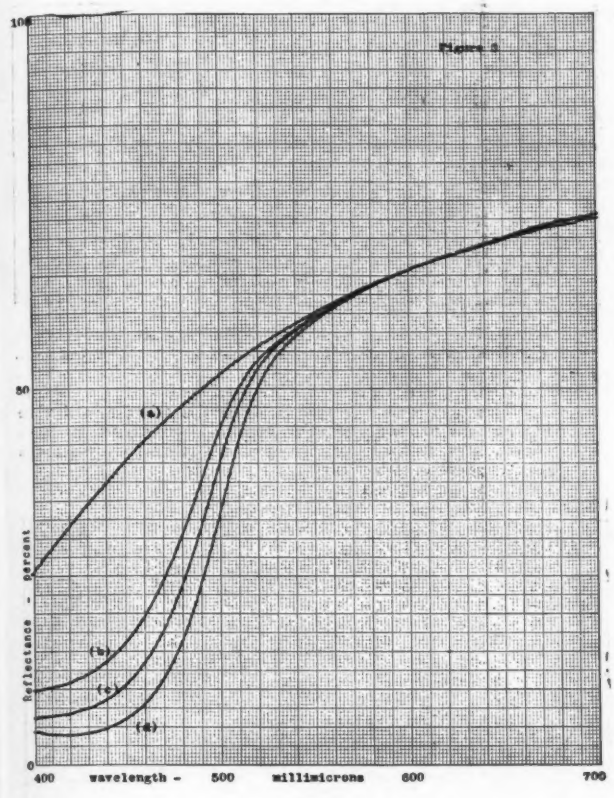

Fig. 3

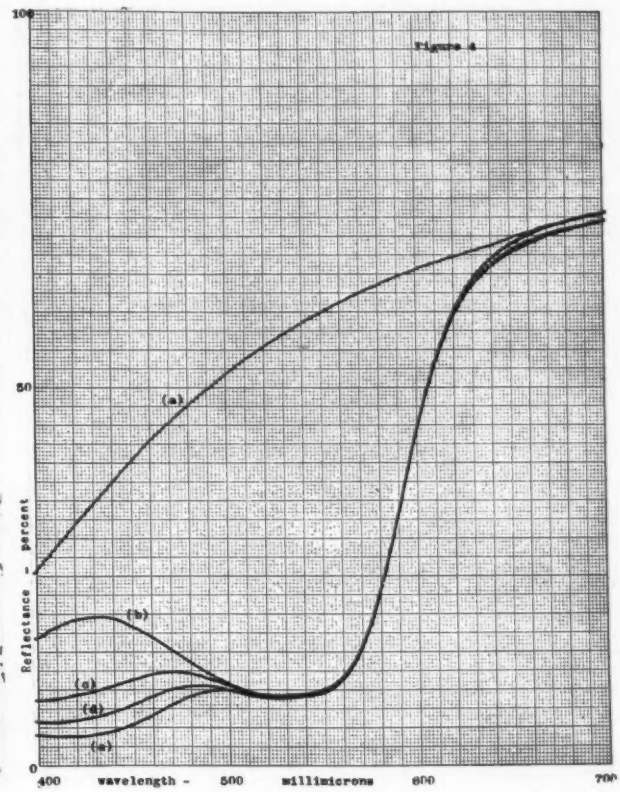

Fig 4

duction of the sensations so that one can comprehend the forces at play.

Undoubtedly the first problem is to formulate the dyeing process so that if one knows the properties of the undyed material and the concentrations of the dyes added, one can predict the properties of the dyed material. The accompanying curves[4] will explain better than words just what the problem is. In Figure 2 is shown the effect of different concentrations of a single dye. Curve (a) is that of undyed wool serge off the bolt; for cloth, the sample seems quite white until compared with a standard surface of magnesium carbonate when it is seen to be the dull yellow which its curve indicates. If this material is put through the dyeing process but without any dye some sizing washed out and other changes lower its reflectance to that indicated by curve (b). Curves (c), (d), and (e) were obtained from three different dyeings of Fast Wool Red GL, the concentrations being respectively 0.125%, 0.25%, and 0.5% by weight of cloth. The red dye allows the red to be reflected quite unchanged and the violet fairly well, but absorbs green strongly. Wherever there is absorption it increases with concentration of dye. The "zero concentration" of curve (b) is seen to be a limiting case and more important than the original material of curve (a). The corresponding concentrations of a yellow dye—Fast Light Yellow 2G—shown in Figure 3 cause absorption in the blue and violet end of the spectrum, but have little effect on the green, yellow, and red.

It is easily guessed what would result from a combination of the dyes—the yellow would be effective only in the blue and violet. In Figure 4 are shown curves for the 0.25% red alone, and in combination with 0.125%, 0.25%, and 0.5% yellow. Although it is not possible at present to predict accurately the result of a dyeing, the curves do show a definite relationship between the component dyes and the mixture. For instance, in Figure 5 is shown undyed silk, 0.5% Pontamine Yellow CH, 0.5% Fast Silk Blue 3GL, and the green formed by the same concentrations together. This behavior is characteristic, and the problem is to formulate the laws which govern in such a case so that from a specification of the original material and the concentrations of the dyes added one can predict the specification of the dyed material. When we have the solution we will be able to work it backwards and determine the concentrations of dyes to produce a required final product. To be able to do this is of real practical importance because if we duplicate a sample in respect to its spectrophotometric curve the two are the same so far as color properties are concerned and will

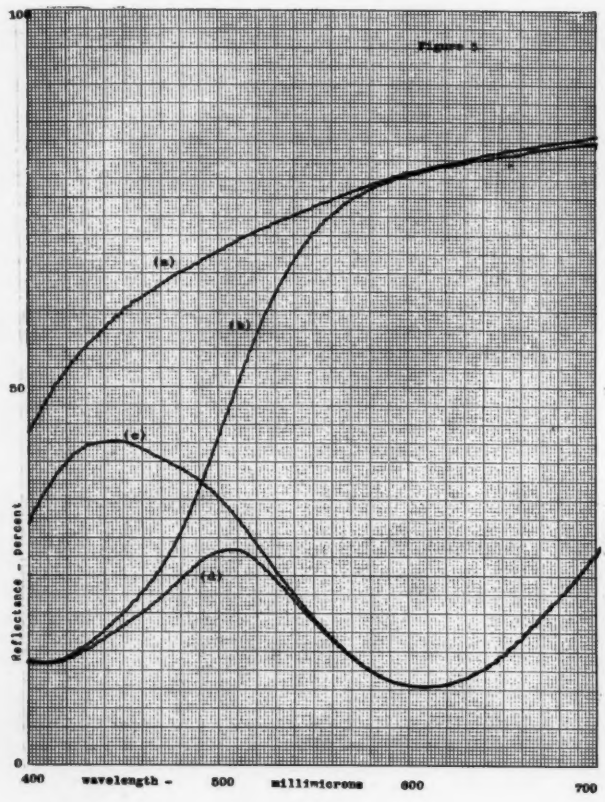

Fig. 5

match under all conditions and to all observers. This objective sort of match can not be made visually, but with the general use of spectrophotometers will become more and more important.

However, in many cases an objective match may be impossible or unwarranted, and inexpensive dyes will be used to produce something really different but which looks the same to a normal observer under certain specified conditions. This may be called a subjective match, and in general will not hold under other conditions or for abnormal observers—this is characteristic of most present-day matches. The second problem is consequently to correlate dye concentrations with sensations so that given a sensation one can determine how to reproduce it in a dyed material under specified conditions of illumination.

These are but a few of the problems of the dyeing industry which the spectrophotometer will help to solve. Other problems and other industries will find the spectrophotometer equally valuable, and it is doubtful if its potentialities as a control and research instrument are at present appreciated even by the most forward-looking color scientists.

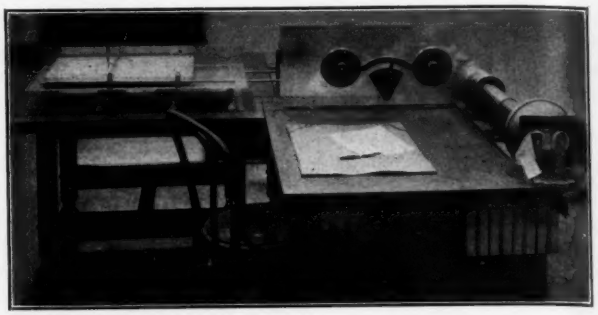

Fig. C—Front view of the new M. I. T. Color Analyzer. At the left is the plotting table where the spectrophotometric curves are automatically traced out. The dials give the wavelength and width of the spectral region for which the sample is momentarily being measured, and the reflectance or transmission of the sample. At the extreme right is seen the integrating sphere painted white inside which collects all the light from the sample and averages out the effect of weave, etc. Light from the sphere enters the photoelectric cell which with its amplifer is placed below the table top.

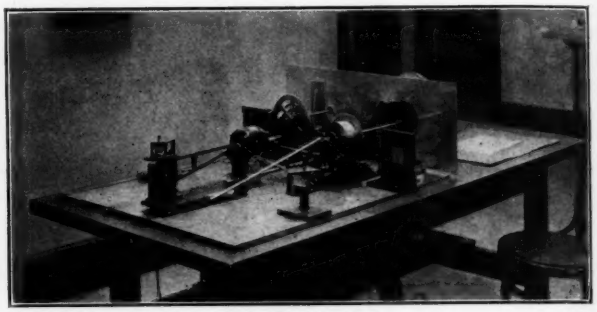

Fig. D—Rear view with plotting table detached. The movable slit which selects the desired wavelength region is seen at the extreme left. On the large gears are cams which give linear wavelength and reflectance scales on the plots.

The principle of operation is briefly as follows: Light from a filament lamp is dispersed into a spectrum by means of a prism and a selected narrow range of wavelengths passes through a slit. Polarizing prisms separate this into two beams of controlled intensities which finally fall on a sample and a standard. These two beams are flickered at sixty cycles in such a way that as the beam is cut off from the sample the other reaches the standard, and vice versa. A photocell views the sample and standard, and in the general case when the intensities of the two illuminating beams are not adjusted to make the sample and standard equally bright, the current from the photocell will flicker. The alternating photocell current is amplified and runs a motor which adjusts the relative intensities of the beams until there is no flicker, when of course it stops. A pen records the relative intensities of the beams, or the relative reflectance of the sample. An independent motor continuously changes the slit and the wavelengths passing through it, and at the same time traverses the plotting paper in the wavelength direction.

References

[1] Publication approved by the Textile Foundation.

[2] T. Smith: The C. I. E. Colorimetric Standards and their Use. Trans. Optical Society, London, Vol. XXXIII, No. 3, 1931-32.

[3] An early model of such an instrument was in operation at the Institute in 1928. Hardy: A Recording Photoelectric Color Analyser. Journal of the Optical Society of America, Vol. 18, No. 2, February, 1929. There will appear shortly a technical description of the new Color Analyzer which embodies several improvements and which is particularly adapted for textile use.

[4] The spectrophotometric curves in this paper are presented merely to show their usefulness and the present product of the M. I. T. instrument. For actual measurements a finer pen will be used, and projected changes in the amplifiers will give a needed increase in sensitivity and less "wavinesss" to the line.

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1933

September 8 and 9

Annual Convention

A A T C & C

American Association of Textile Chemists and Colorists

Convention Headquarters, Congress Hotel, Chicago

Proceedings of the American Association of Textile Chemists and Colorists

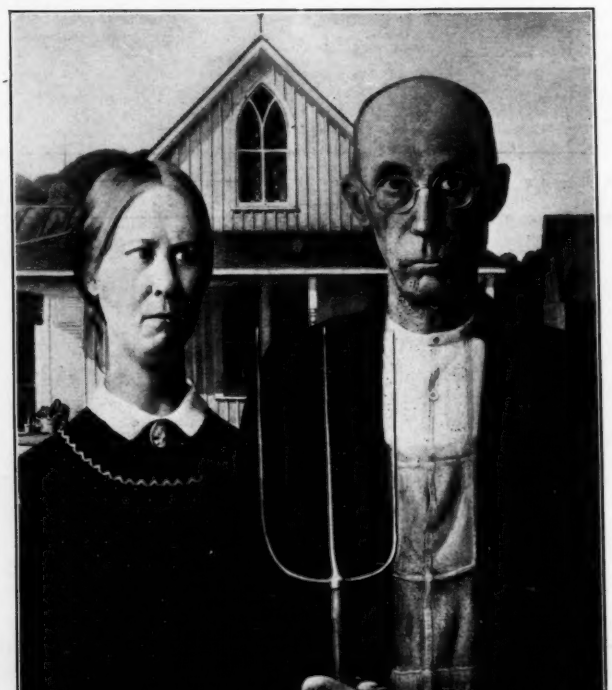
The Century of Progress Art Exhibition

THE exhibition of Paintings and Sculpture celebrating "A Century of Progress" has been assembled (with one exception), entirely from American sources. It is the most important collection of masterpieces yet to be shown in America. Thirty-one art museums and two hundred private collectors have contributed their most valued treasures. The value of the exhibition approximates seventy-five million dollars, almost twice the value of the entire Chicago World's Fair of 1893.

The paintings and sculpture are arranged in sequence from the 13th century down to the present time, so that the visitor may enter the Gallery of the Primitives and pass from room to room, down to the work of the present day.

In all there are approximately eight hundred paintings, over three hundred water colors, one hundred and thirty-five pieces of sculpture and three hundred etchings and engravings.

There are gallery tours and guides as well as private guide service by appointment. The general tour starts week days at 9.30 A.M. and on Sundays at 1.00 P.M. The lecture in the galleries on a selected section of the exhibition takes place week days at 11.00 A.M. Admission is only twenty-five cents.



Grant Wood — *American Gothic*

Courtesy of the Art Institute of Chicago

For those members who expect to attend the convention and who will not be able to give much time to the exhibition, the following list is a suggestion of some of the "high-spots" which should not be missed:

No.
13. *Cranach*, Crucifixion.
20. *Holbein*, Portrait.
34. *Breughel*, Wedding Dance.
57. *Brouwer*, The Smokers.
65. *Hals*, The Merry Lute Player.
73. *Rembrandt*, Aristotle with the bust of Homer.
80. *Vermeer*, Woman Weighing Gold.
94. *Sassetta*, Journey of the Magi.

No.
108. *Botticelli*, Madonna and Child.
140. *Titian*, Venus and the Lute Player.
162. *Goya*, Bull Fight.
170. *El Greco*, Archbishop of Toledo.
210. *Chardin*, The Industrious Mother.
217. *Ingres*, Mlle. Jeanne Gonin.
237. *Courbet*, Mere Gregoire.
283. *Degas*, Dancers.
307. *Cezanne*, The Card Player.
338. *Renoir*, Bather.
364. *Gauguin*, Two Tahitan Women.
434. *Bellows*, A Stag at Sharkey's.

No.
453. *Duveneck*, The Whistling Boy.
490. *Whistler*, Portrait of the Artist's Mother.
645. *Speicher*, Babette.
673. *Bonnard*, Breakfast Room.
730. *John*, Portrait of Dr. Streseman.
773. *Duchamp*, Nude Descending the Stairs.
666. *Wood*, American Gothic.
568. *Hopper*, Automat.
536. *Curry*, Baptism in Kansas.
460. *Homer*, The Herring Net.
738. *Rivera*, The Rivals.

Though the theme of this exposition is a hundred years' progress in American collecting, all those works shown being either owned by the Art Institute of Chicago or lent by American collectors (with the exception of the Whistler Portrait of His Mother), the visitor should not fail to see the progress in truly American art, as well as recognize the progress in American collecting of Europeans.

The painting reproduced is truly American and is the work of Grant Wood, a distinguished American painter from Iowa. It is, by purchase, a permanent acquisition of the Art Institute of Chicago.

In 1833 very few great works were on this side of the Atlantic; today the United States possesses treasures of amazing quality, inspiring not only to our artists but to the rapidly growing public, who are coming to feel the need of art in their daily lives.

The exhibition includes works rarely if ever seen by the public, emphasizing in this way the resources of the nation, and offering a privilege to the visitor which undoubtedly will never be duplicated.

The very comprehensive and authoritative catalogue includes over 175 reproductions; it is well printed and sells for $1.00 in paper binding and $1.50 in substantial cloth binding and its purchase is strongly recommended.

As the reader no doubt has realized, the exhibition herein described is housed in The Art Institute of Chicago, at Michigan Avenue and Adams Street, which is not within the World's Fair gates, but is close to the Congress Hotel, convention headquarters of the A. A. T. C. & C.

Proceedings of the American Association of Textile Chemists and Colorists

UNEMPLOYMENT REGISTER

Members of this association, who are without employment, should forward to the secretary a statement as to their qualifications and experience. This information will subsequently appear on these pages with an identifying key number. Employers are also requested to file with the secretary any vacancies which may occur in their businesses.—A. Newton Graves, Secretary, care Franklin Process Company, Providence, R. I.

Key: A—Laboratory and research; B—Dyeing or printing; C—Finishing; D—Sales; E—Instruction; F—Executive

NOTE. Persons who have obtained employment should notify the secretary at once. Prospective employers may file vacancies either with the secretary or the AMERICAN DYESTUFF REPORTER.

A-1

Education—Ph.B., Brown Univ. '27, P.G. at N. C. State (M.S. this June).

Experience—several years experience as an analytical and research chemist; private research work on sulfonated oils. Twenty-seven years old, married. Will supply references.

A-2

Education—B.T.C., Lowell Textile Institute, 1932; also course in shorthand and typing.

Experience—None to date, interested in quantitative analysis, experimental dyeing, color matching, dye testing and dye identification. Ability to learn quickly and will go anywhere. 23 years old, single.

A-4

Education—Sc.B.Chem., Boston University, 1929. Short course at Mass. Inst. Tech. on microscopy and textile testing.

Experience—Employed in print works of mill, to May 1931,—laboratory work on chemical analysis, dye testing, trouble shooting and development work. To January 1933 was employed by textile specialty manufacturer doing analysis and product duplication, and also plant control and development work.

A-B-1

Experience—over twenty years' experience in the laboratories of various chemical manufacturers, four months' experience as second hand in dye house, familiar with all types of dyes and fibers. Thirty-nine years old. Will supply references.

A-B-2

Education—Lowell Evening Textile School, 1917.

Experience—Five years' experience in hosiery dyeing, full fashioned hosiery of silk and cotton and silk, also men's hosiery containing rayon, wool, cotton and celanese. Several years experience in laboratory work. Has also had experience in jig-dyeing of cotton piece goods, slub and top dyeing.

A-B-E-1

Education—B.S. in chemistry at C.C.N.Y. Working now on M.A. at Columbia.

Experience—7 years as dye tester and color matcher for dye manufacturer; 6 months skein silk and rayon dyer; 4 years textile chemist and dyer for cotton finishing concern; 2 months boss bleacher and 4 years as teacher of organic chemistry and dyeing. Age 38, single.

A-E-1

Education—Ph.D., Univ. of Illinois, studied chemical engineering at Columbia, licensed chemical engineer, New Jersey.

Experience—10 years' experience teaching in colleges, subjects included chemical and textile subjects. Has had broad experience in industrial work including experience in testing materials, research and consulting. Will go anywhere; references.

A-E-2

Education—B.T.C., Lowell Textile Institute, 1933.

Experience—Assistant instructor in chemistry, Lowell Textile Institute. Member of scholastic honorary fraternity.

B-1

Education—educated and trained in chemistry and calico printing in Glasgow, Scotland.

Experience—Has been with large print works as colorist for 13 years producing first class work on cotton, rayon, wool and silk fabrics. References.

B-2

Experience—Boss dyer with one firm for 18 years, divisional supt. at print works for 1 year, in charge of processing and dyeing of cottons and rayons at large bleachery for 6 years. Prefers bleachery in East but will go anywhere. References.

B-3

Experience—Foreman piece dyer for the past 21 years. Can dye the following; celanese, rayon, cotton backs, wool, silk and mixed fabrics. Has knowledge of finishing and laboratory work.

B-6

Education—Graduate R. I. School of Design.

Experience—5 years in bleachery, 7½ years as assistant dyer, 2 years as boss dyer and 3 years as superintendent of dyeing and finishing. Married, 33 years old. References.

B-7

Experience—4 years as assistant to manager in ribbon mill; 2 years as boss dyer on veils, chiffons and silk skeins; 5 years as boss dyer on ribbons and skeins (cotton and silk); 7 years as boss dyer on spun silk (pure dye and fast) resisted colors; last 12 years as hosiery dyer on silk and cotton, silk-cotton, rayon or wool. 50 years old, married. References.

D-1

Education—Graduate textile course, 1911, Georgia School of Tech.

Experience—Has had experience in all branches of the textile industry but chiefly in sales work. Was at one time in the dyestuff business and later in hosiery manufacturing. Prefers Middle Atlantic or southern states.

F-1

Education—Textile Institute, Alexander Hamilton Inst., Extension work at Brown Univ., working knowledge of German.

Experience—Has had executive departmental work with all types of textiles manufacturers. Acquainted with all types of textile machinery, dyestuff application, laboratory practice, cost methods, and checking methods and processes. References.

B-D-F-1

Experience—Has held positions as general superintendent of a print and dye works and a finishing company; held a position as boss dyer in a bleachery for 6½ years and as a colorist on 11 printing machines for 3½ years; has held a position as boss dyer for 6½ years with a finishing company and received general training for 3½ years; and has also been dyer in a mill dyehouse. Desires position as superintendent, colorist, dyer or salesman and solicitor.

WHAT THE MICROSCOPE SHOWS

(Continued from page (255) 469)

Wool is a nitrogenous material of varying composition. The wool fiber has a definite structure. The surface of a wool fiber is covered by interlocking scales. These scales vary considerably in size and shape from one wool to another. Considerable variation is even found in the fibers from a single sheep. The characteristics of these scales are said to influence the spinning and fitting properties of the wool.

Through the center of the wool fiber there is a central channel or medulla running to the tip of the fiber. This channel contains cellulose material as well as the pigment that gives the wool its color.

The main body of the fiber is made up of lone thin fibrous cells which are bound closely together.

The cross-sections of wool fibers vary from round to oval and have a somewhat irregular shape.

Occasionally there are found wool fibers that are very round in cross-section and have a large central channel filled with air. These are known as kempy fibers. They are highly resistant to chemical attack and to dyes.

Silk is very similar to the rayons in physical structure. The filaments are very long cylinders without a central channel.

In raw silk we have a gummy material surrounding the main body of the filament.

There are no special markings on cultivated silk. In the raw silk two filaments are usually bound together by the silk gum.

Silk is not perfectly round as commonly supposed. The cross-sections of silk varies from an oval to a triangular shape. Good silk is usually associated with an oval cross-section.

The other natural fibers such as jute, ramie, flax, and hemp are characterized by surface markings, by the presence or absence of a central channel and by the shape of the cross-sections.

AMERICAN
DYESTUFF
REPORTER

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Published biweekly by
HOWES PUBLISHING CO., INC.
440 Fourth Avenue, New York City

A. P. HOWES, President
M. D. REESER, Secretary
H. F. CRAWFORD, Treasurer

Subscription price: $5.00 per year; Canadian $6.80; foreign $6.00

Vol. XXII July 31, 1933 No. 16

THE BLANKET CODE

WITHIN a day or so after the President's appeal to the nation for support of his blanket code proposal for all industry, more than 10,000 messages had been received at the White House pledging this requested support. This action has been more or less convincing of the fact that this code for higher wages and shorter hours will shortly be in operation all over the country. It is rather significant that the President does not intend, for the present at least, to do anything to force the adoption of this code except through the medium of public opinion. Even this will not be brought to bear particularly harshly upon unwilling manufacturers. It is expected by the Administration that no such action will be necessary to bring the delinquents into line.

The thought had been expressed at a recent Executive Council meeting that the President was too lenient in this respect and it was suggested that a list of retail and wholesale dealers should be placed conspicuously in post-offices or elsewhere and those who adopt the code should be indicated by a star. However the President's plan is to list only those who accept the code and hence does not hold open to graphical criticism those who do not accept. Judging from this fact it is evident that the President does not consider that such measures will be necessary to the success of the measure, and the nation-wide approval that has been expressed to date indicates that there is considerable basis for such deduction. It further indicates, to a large extent, that labor and industry are profoundly interested in the code and its provisions and are anxious to cooperate sufficiently to make the plan successful.

The method of approach used in securing country-wide adoption of the code was very effective indeed. Instead of forcing it down the throats of everyone without further ado, the idea of showing how and why such a plan was necessary to a continued improvement in economic conditions was just the right psychological treatment at this time to bring about voluntary acceptance of the code. After all, most of us would rather decide for ourselves what to do, rather than be forced into doing something, even though we would eventually come around to the same way of thinking by ourselves.

There will be, no doubt, loopholes in the code that industrialists will discover and use to their advantage. The opinion has been expressed that such cases will be left up to the "spirit-of-fair-play" supposedly inherent in all of us, condemning such action and eliminating it. Just how effective this will be and how strongly the consciences of some of our business men will be smitten we are at a loss to say. Judging from past performances in regard to cutthroat competition, graft, and other "unfair trade practices" it will probably not be of much use, but at the present time the words of Administrator Johnson aimed at this particular subject seem to contradict such events: "Of course there are ways to beat the rules of the game. We know what they are. We are not issuing any regulations about that. We are just asking people in this crisis, in very general terms, to rise above these cheap little ingenuities and to join with the President to beat the depression and not to beat the rules of the game."

The expressed purpose of the blanket code is to bring purchasing power up to the level of prices which are slowly but steadily rising and are in most cases way ahead of the pocketbooks of a great many. In this particular circumstance, the only method to bring up purchasing power is to raise wages so as to enable people to buy and prevent another collapse. The Blanket Code seems to have been the only logical method of solving this problem. Whether it will or not depends upon the support it is given and from all appearances and expressions to date it is not too optimistic to expect some improvement. For one thing it has given hope and encouragement to a great group of people who have been living on starvation wages or on charity, and taking away the fear of unemployment in such people and offering them more money will loosen up a great deal of buying power. It doesn't do any good to change goods from the shelves of the manufacturer to those of the retailer if the consumer is not in a position to make needed purchases.

Administrator Johnson hailed the many acceptances of the President's appeal in the following flowery expression: "—— the men and women of a great nation . . . suddenly stirring to one man's voice and rising together like a vast army from a dismal bivouac at a clear bugle call at daybreak." We cannot express ourselves quite so artistically but we hope that the President's faith in the patriotism of our citizens is not without adequate foundation.

TEXTILE FOUNDATION NEWS

The improved appearance and strength of cotton fabrics that have been mercerized are matters of general knowledge and considerable appreciation on the part of the consumer. While the process has been employed for some time, the manufacturer in his desire to capitalize the utmost possibilities of mercerization is still experimenting to obtain maximum benefits. Because of that interest, research has been instituted by the Textile Foundation to further knowledge of the process and methods of application.

"Some faulty conclusions have arisen concerning the cause and effect of mercerization," says John B. Calkin, Fellow of the Textile Foundation, working under the direction of Professor Wilder D. Bancroft at Cornell University.

"Certain investigators have ascribed to cellulose the property of forming definite chemical compounds with caustic soda, thus accounting for mercerization," states Mr. Calkin's report made public recently. "The first compound claimed by this group, sodium cellulose, is said to occur at about 16-25% caustic solution. Other investigators have arrived at their conclusions on the formation of definite compounds by erroneous application of the phase rule propounded by J. Willard Gibbs.

"Our results and the interpretation of certain other results, indicate that only a partial picture is given by the usual method of attack," Calkin states. "We have found three different curves under the following conditions: (1) native cotton with increasing concentration of caustic solution; (2) native cotton pretreated with sufficiently concentrated caustic solution, washed and air dried; and (3) cotton with decreasing concentration. Cotton pretreated with caustic solution will take up more caustic soda or dye from respective solutions but there are indications that it is possible, at least in part, to reverse this condition. So far none of our data give evidence of the formation of the sodium cellulose compound.

"The method developed by Vieweg, whereby the caustic taken up is calculated by determining the change in concentration before and after adding the cellulose, has been our line of approach to date. This method gives low values, as it is applicable only where no solvent is taken up by the solid phase. The water from the caustic solution is taken up by the cellulose. Two investigators have published results on centrifuging. We shall try the centrifuging method as a means of ascertaining when all the excess caustic solution has been removed.

"Results of our research show a higher value for the amount taken up from alcoholic caustic solution than from aqueous solution. We have found by the use of cellophane, a non-fibrous form of cellulose, that cellulose takes up little, if any, absolute alcohol when immersed in the pure solvent. With these facts as a basis we are turning our attention to the role of the caustic and of the water in mercerization," Calkin reports.

CHEMICAL ANALYSIS OF COLORED SOLUTIONS

THE treatment of colored liquids in analysis is a problem which is being rendered more acute as the use of dyestuffs in everyday life increases. At one time artificial dyes were confined almost entirely to such purposes as the coloring of textiles, leather, etc., but now they are known to be present in hundreds of other less likely products.

Thus it comes about occasionally that the problem before the chemist is not the utilization of color, but how to destroy it so that the usual tests dependent on natural color change can be applied.

Strangely enough, this subject has received little attention in the literature of dyeing although it is so closely connected with it, and what information there is appears to be scattered.

There are a few methods of testing acidity of colored solutions (ink in particular) given in Mitchell and Hepworth's "Ink Manufacture," which might admit of more general application.

As is well known, the amount of acid in an iron-tannate ink is an important factor. Too much of it makes the fluid corrosive while too little makes it unstable and liable to form a sediment on keeping. A small quantity of free acid (e.g., hydrochloric) keeps the iron salts in the unoxidized, soluble form.

One method sometimes employed, though by no means above criticism, is to put weighed steel nibs into a measured amount of the ink and find the loss in weight caused by the action of the acid. This recalls the method of determining free acid in wool once suggested, namely, boiling it in water together with a weighed crystal of Iceland Spar (calcium carbonate).

Another method, due to Mitchell, said to give better results, is that of distilling the sample with Sodium Acetate previously rendered neutral. The mineral acid present replaces acetic acid in equivalent amount and this being volatile is collected in the distillate and titrated. When any quantity of organic matter is present, three distillation processes are said to be required.

Boiling the ink with 10-volume hydrogen peroxide under a reflux is another method. By this treatment the color is said to be destroyed. (See Analyst, 1921. 46. 131.)

A recent contribution to the subject is due to Hibbard. (Ind. & Eng. Chem., July, 1932, page 283). The method consists of destroying the color by nascent bromine and since the process is claimed to be applicable to dyestuff solutions, it may be mentioned here.

50 cc. of the colored solution is taken and to it is added 5 cc. of saturated bromine water and 5 drops of 5-normal caustic soda thus giving sodium hypobromite.

To the mixture is then added 5 drops 5-normal hydrochloric acid. Free bromine is now evident, if it is not, the process is repeated. The excess halogen is removed by sulfite of soda or by boiling.

Rayon Dyeing and Finishing-II

By **B. L. HATHORNE**
Consulting Textile Chemist

CHAPTER VI—DYEING AND FINISHING OF TRICOT AND MILANESE FABRICS

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(Continued from page 456, July 17th issue)

Bleaching Procedure for Regenerated Cellulose Rayon and Real Silk Tricot Fabric

Per 100 *Pounds*

(1) Scour as usual.
(2) Rinse thoroughly.
(3) Prepare bleaching liquor in special bleaching tub as follows:—
  (1) 10 lbs. 100 volume hydrogen peroxide.
  (2) 8 lbs. silicate of soda.
  (3) ¼ pound sulfonated castor oil.
(4) Raise temperature of bath to 130° F.
(5) Enter previously scoured fabric.
(6) Work in cooling bath approximately every one-half hour for two hours.
(7) Allow goods to stand overnight.
(8) Rinse in dye machine.
(9) Blue—preferably with Indanthrene colors as follows:—
  Per ten gallons liquor
  1/16 oz. Indanthrene Blue 2GSZ
  1/16 oz. Indanthrene Blue RZ
(10) Finish and dry as usual.

Care must be taken that the bleaching tub does not contain iron, that only lead pipes and fittings are used throughout the tub, and that all pipes and fittings inside the tub are covered with wood in order to prevent the fabric from coming into direct contact with such pipes.

Discussion of Dyeing Problem

The dyeing problems and methods of handling all rayon and rayon-cotton glove silk fabric are so similar to the handling of circular knit rayon fabrics, that the same will not be discussed in detail here. A full discussion of the dyeing of circular knit rayon fabrics is given in Chapter V.

Real silk and rayon glove silk fabrics are usually dyed in a soap bath with so-called "union" type direct cotton colors, that is, colors that have a greater affinity for rayon than for silk at low temperatures and a greater affinity for silk than for rayon at high temperatures.

The dyeing is started at room temperature and is very slowly raised to a temperature at or just under the boil. Depending upon the dyestuffs used, the temperature is usually maintained relatively low—room temperature to 140° F.—until the rayon has been dyed a deeper shade than is required in the final match. The temperature is then raised slowly to the boil and is maintained just under the boil until a proper union effect is obtained.

As many of the so-called union colors give slightly different shades on real silk than on cotton, it is usually necessary to shade the real silk with small quantities of neutral dyeing acid colors.

In many instances, in order to obtain the required shades, it is necessary to dye rayon with colors having little or no affinity for the real silk and to use neutral dyeing colors to color the silk portions of the fabric.

It is to be regretted that the affinity of real silk for many direct cotton dyestuffs, particularly when processed for appreciable periods of time at high temperatures, prevents the use of many of the dyestuffs that would materially reduce the barre effect obtained in tricot fabrics. Due to this fact, more barre trouble is experienced in real silk and rayon, tricot and milanese fabrics than in the other types of knitted rayon-containing goods.

The following procedure is typical of the procedures used in the production of union effects on real silk and rayon glove silk fabrics:

Procedure—Real Silk and Rayon Glove Silk Fabric

Per 100 *Pounds of Goods*

(1) Fill machine with water.
(2) Load machine.
(3) Add 3 lbs. soap.
(4) Add necessary dyestuffs.

(5) Run machine at room temperature 10 minutes.
(6) Raise to 130° F. during 10 minutes.
(7) Add 3 lbs. Glauber's salt. Run 15 minutes.
(8) Raise to boil during 20 minutes.
(9) Run just under boil until union is obtained.
(10) Drop bath, rinse and finish.

All-acetate tricot and milanese fabrics are dyed in the same manner as are rayon and rayon-cotton fabrics with these exceptions:—

(1) Dyestuffs having affinity for cellulose acetate fibers must be used.
(2) Temperature of the dyeing bath should not exceed 180° F. at any time.

The dyeing of real silk and acetate combinations differs from the dyeing of all-acetate fabrics only in the selection of dyestuffs. The affinity of real silk for some of the acetate dyestuffs is so great that they cannot be advantageously used in conjunction with real silk and acetate combinations.

Very pleasing cross-dyed effects on real silk and acetate combinations can be produced in a single bath by the use of neutral dyeing acid colors combined with acetate colors that have little or no affinity for the real silk.

Discussion of Scrooping Problem

The application of a scroop finish to rayon-containing glove silk fabrics is so dangerous that it should be avoided whenever possible and, when necessary, should be carried out with the utmost care and careful attention to detail.

Thousands of dollars worth of rayon-containing tricot fabrics, and garments made from the same, have been rendered absolutely worthless because of the *improper* application of a scroop finish.

At first thought, it would appear that the application of minute quantities of a volatile organic acid, such as acetic, formic, could not injure rayon in any way, as these acids should volatilize within a comparatively short time.

Such would be the case if the fabric was scrooped, dried at a relatively low temperature, manufactured into garments, and sold in that condition. The joker in the situation is the *pressing* operation, to which the finished garments are subjected before shipment. The high heat used in the pressing operation can cause small quantities of volatile organic acids to carbonize or partially carbonize the rayon present, thus causing it to fall from the garment as powder or to be so materially weakened as to dust off from the goods during the first wearing.

Fortunately, fatty substances such as the free fatty acids of the common soaps have so much more affinity for minute quantities of volatile organic acid than do regenerated cellulose rayon, that it is possible to scroop rayon-containing fabrics by depositing sufficient free fatty acid on the outside of the individual filaments, to retain the necessary scrooping acids.

Care must be taken that the quantity of free acid used is very slight in order that the bulk of the minute quantity of acid used will be retained by the free fatty acid.

The procedure given below has been successfully used to scroop real silk and rayon tricot fabric under a given set of conditions. It should not be assumed that this procedure can be used exactly as given under another set of conditions.

After dyeing scrooped fabric should be carefully tested under the following conditions:—

(1) Heat on iron to 500° F. (temp. can be easily measured by drilling a hole just large enough to contain a thermometer to the center of the iron from the side parallel with the bottom.
(2) Place fabric upon an ironing board.
(3) Place previously heated iron upon the fabric for 10 seconds.
(4) Remove the iron.
(5) Test fabric for strength. If it is as strong as untreated fabric the scrooping treatment is satisfactory and safe.

Scrooping Procedure—Real Silk and Regenerated Rayon Fabric—Dyed Fabric

Per 100 *Pounds of Goods*

(1) Fill machine with water at approximately 100° F.
(2) Add 5 lbs. previously dissolved soap.
(3) Run the fabric for 5 minutes.
(4) Add sufficient acetic acid or formic acid, or a mixture of both to produce desired scroop on dried fabric. Exact amount cannot be specified here as condition of kettle (absorbed soap), etc., make changes necessary from plant to plant. One pound of 30% acetic is sometimes found sufficient. Excess acid *must be avoided.*
(5) Run goods 10 minutes.
(6) Extract thoroughly and tenter as soon as possible. (If necessary to hold goods more than two or three hours before tentering operation, wrap in cotton cloth previously wet out in scrooping bath.)

Discussion of Drying

After extraction, tricot and milanese fabrics are stretched taut on the tenter frames described earlier in the chapter, where they are allowed to remain until dry. As rayon-containing tricot and milanese fabrics can be seriously weakened by drying under too much tension, it is essential that the tenter frames be set at proper width for each cut, and that the fabric be stretched on the frames that the tension is as uniform as possible in all directions.

Excessive tension applied during the drying operation not only increases the fabric area, but reduces the shrink of the finished fabric. These two advantages sometimes cause tricot manufacturers to overlook the fact that excessive tension applied to the fabric during the drying operation reduces the wear of the same. Tricot fabrics are sometimes stretched to such an extent that the elastic limit of the yarn is exceeded, and the yarn is permanently distorted. This prevents shrinkage to a very considerable extent, but reduces the wearing qualities of the finished product to an even greater extent.

(To be continued)

Technical Notes From Foreign Sources

Pretreatment of Viscose for Level Dyeing

German Patent No. 462,199 (14/VI/'28) — *Chem. Fabrik von Heyden A.-G. in Radebeul b. Dresden.*—The treatment consists in a mild bleaching, in some case only a pretreatment, of the viscose in a 2% bath of p-toluene-sulfon-chloramide, as the sodium salt, at the ordinary temperature; if bleaching is desired, until the desired degree of bleaching is reached; if not, for a desired short period. The result of the treatment is claimed to be, the avoidance of unlevel and streaky dyeings, so much dreaded with viscose.

Developed Dyeings with Acetate Silk

German Patent No. 465,423 (30/VIII/'28) — *I. G. Farben-Ind. A.-G.* — Ureas, simple or substituted, are known to exert a favorable influence upon the taking up of basic dyestuffs by acetate silk, when dyeing in the ordinary way. In the present case, the idea is applied to the use of developed colors, the urea being added to the padding bath. One advantage claimed is, that less free alkali is needed for penetration of the goods. With components of the Naphthol AS series, it is of advantage also to add formaldehyde, as is frequently done in ordinary Naphthol AS dyeings. Two examples are given.

Vat Dyestuffs (Indigoid Series)

German Patent No. 469,178 (22/XI/'28)—*I. G. Farben-Ind. A.-G.*—In German Patent No. 105,200, certain benzocumaronone-carboxylic esters are cited. If these are hydrolyzed with mineral acids by heating, the free acids obtained can be condensed with 2-derivatives of an isatine, a 2-3-diketo-dehydrothionaphthene, a cumaronone, a penthiophene, or an o-diketone, etc., to form useful vat dyestuffs, which are not destroyed by the alkali of the vat, as are the oxygen isologues of indigo. The two examples given cover a red-violet and an orange-red dyestuff.

Vat Dyestuff Intermediates (Perylene Series)

German Patent No. 465,989 (13/IX/'29) — *Felice Bensa, Genoa.* — Halogen derivatives of perylene are treated with conc. sulfuric acid at a high temperature, thus bringing about oxidation to quinonoid perylene derivatives, useful for further syntheses. The products are isolated by dilution of the acid mixture with water. Seven examples are given.

Vat Dyestuffs

German Patent No. 469,564 (29/XI/'28)—*I. G. Farben-Ind. A.-G.* — The products covered are sulfaminic acids (or derivatives of them) of the amines of the anthraquinone series. The usual method of preparing such compounds in general by action of chlorsulfonic acid or its esters, etc., upon the amino compounds, involves generally the use of an extra mol. of the amino compound, to neutralize the halogen acid set free by the reaction. This method cannot be used in the case of the amino-anthraquinones (in such compounds the basic properties of the amino group are too weak to allow the formation of stable hydrochlorides), and therefore tertiary bases, such as pyridine, diethylaniline, etc., have been used as the neutralizing agent, and unavoidably also as diluting media.

The present patent simply covers the use of ammonium hydroxide or a primary amine, such as aniline, for the purpose. Three examples of the carrying out of the method are given.

Mordant Azo Dyestuffs

German Patent No. 466,381 (20/IX/'28)—*J. R. Geigy A.-G.*—German Patent No. 454,460 describes the preparation of certain diaryl-methane derivatives, containing an amino group in one ring, and an o-hydroxy-carboxylic grouping in the other. If such compounds are diazotized and coupled to any suitable second component, the azo dyestuffs formed are suitable (through the o-hydroxyl-carboxylic grouping) for printing in mixture with chromium salts, or for dyeing as usual, followed by after-chroming. Two points are noteworthy, that the nitrous acid involved in the diazotization does not either split the diaryl-methane derivative, or oxidize it to the carbinol condition, by oxidation, as is so often the case; also, that the brilliance of the dyeings is so great, approaching in some cases the brightness associated with the triaryl-methane basic dyestuffs. The dyeings are very fast to light, washing, chlorine, fulling, potting, etc., as would be expected from the presence of the salicylic acid—chromium mordant association. One example is given.

Wool Fast Navy Blue FTL

Under the above name the Geigy Company has placed on the market a new wool dyestuff, dyed from a weakly acid bath, for the production of dark navy blues on wool piece goods, particularly ladies' and men's wear materials of every description, said to give an attractive and bright overhand tone. Its fastness properties are reported to be exceptionally satisfactory.

Lumber Bi-Products, Inc.

Lumber Bi-Products, Inc., 702 M. & T. Bldg., Buffalo, New York, have enlarged their activities by establishing a Wood Flour Division, recently purchasing the assets of the former New England Mills at Manchester, N. H. The plant covers 6½ acres. There are two railroad slidings to accommodate 12 cars of raw material and eight cars of finished product, at the same time. The present production is approximately 1,500 tons per month of various grades. "Wood Flour" is finely pulverized wood, which is refined into several grades and used as a cheap filler in numerous formulas to replace more expensive ingredients. Samples sent gratis, upon request. M. J. Watson, president, has been associated with the wood flour manufacturing industry since 1920, and is familiar with the grades desired by the diversified industries.

Scholler Bros. New Warehouse and Office Building

Scholler Bros. Inc., of Philadelphia have placed a contract for the erection of a new warehouse, to occupy a full city block located on the Philadelphia and Trenton Branch of the Pennsylvania R. R. The area for finished stock storage will occupy about 57,000 square feet and the raw oil storage building will accommodate 250,000 gallons of palm, castor and such oils and tallow. The siding, elevated with ample platform facilities served by an elevator of 8,000 lbs. capacity and accommodating three car loadings, will permit receiving carload quantity in bulk of all oils and facilitate carload shipments of finished goods.

Considerable area has been provided for general offices with six private offices and a general meeting room for salesmen. The executive quarters are centralized in the midst of the records, sales, storage and shipping departments. The present offices will be removed and complete modern laboratories will be installed. It is stated that the new plant will enable the company to more economically meet the demand for its line of soaps, sulfonated oils, finishing compounds and specialties for textiles.

Millinery Colors for Early Fall

The Color Conference Committee of the Eastern Millinery Association, in cooperation with the Textile Color Card Association, has recommended the following fifteen shades for the early 1933 Fall Season:

Brown Taupe, Mole Taupe, Towngrey, Friar Brown, Chona Brown, Burnt Brown, Orange Laque, Mulberry Red, Fez Red, Dundee Green, Hindu Green, Doebeige, Hempbeige, Corbeau Blue, Matelot.

In choosing these shades, careful thought was given to the fashion trend in costume colors for early Fall.

All of the above shades, with the exception of Matelot, repeated from the 1933 Spring Card, have been selected from the 1933 Fall Silk and Woolen Cards issued by the Textile Color Card Association.

Textile Color Card Association Scholarships

At the commencement exercises of the New York Textile High School held the evening of June 27th, Stephen Harris, a member of this year's graduating class, was awarded the Textile Color Card Association's Scholarship established at that school for the year 1933-34.

Mr. Harris, who won the award because of his exceptionally fine work in color as applied to textiles, will receive the amount of the scholarship in ten monthly payments during one year of post-graduate study and research in color at the above school.

In addition to the above, the color organization has also awarded scholarships for the year 1933-34 to Edward William Croner at the Philadelphia Textile School and Russell M. Lawson at the Lowell Textile Institute. At the close of the coming academic year, each student will be required to present a thesis on color.

These represent the fifth annual scholarships given by the Textile Color Card Association to exceptional students at the textile schools mentioned. The terms and purposes of the awards have been formulated according to individual plans with the principal of each school.

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The rate for "Position Wanted" advertisements in this column is 2 cents a word—with a minimum of 50 cents per insertion. For all other types of advertisements—i.e., help wanted, machinery or supplies for sale—the rate is $5.00 per column inch or less per insertion.

Position wanted: Secretary to textile consultant desires connection in the textile industry in New York City. Several years of experience in textile publishing and textile research laboratory fields. Thoroughly familiar with general textile terms. Address Box No. 783, American Dyestuff Reporter, 440 Fourth Ave., New York, N. Y.

Position Wanted: as Boss or Asst. Dyer on Silk Hosiery Full Fashioned and Seamless. Thoroughly experienced in all stages of Hosiery Redyeing and Grey-Stock; close matching; Full particulars and first class references furnished upon request. Salary of secondary consideration; Married. Location no object. Address Box No. 784, American Dyestuff Reporter, 440 4th Avenue, New York City.